changes in weather, pests, and crop diseases. These consequences counsel against wholesale conversion to similar farming techniques in the Third World, where modern inputs are not generally used. How, then, is the Third World to avoid chronically inadequate food supplies or continual dependence on food aid? Many alternatives were suggested by the speeches at Wingspread.

Per acre yields are currently so low in many parts of the developing world that small amounts of fertilizer or irrigation could boost yields dramatically in the near future. At the same time, more equitable distribution of land and other forms of wealth would enable the poor to invest more in their agriculture and ultimately to grow and buy more food. Farm policies that give farmers a good price for their crops would probably bolster production. Pricing policies, international assistance, and agricultural extension programs that encourage the development of many different kinds of crops, including indigenous legumes, roots, and tubers, would help feed more people. Ehrlich pointed out at the Conference that "when high-yielding rice or wheat is grown in place of beans, more calories but less protein and some other nutrients are produced." If cash crops like coffee or sugar are encouraged instead of food crops, the consequences can be worse.

The adequacy of food supplies now and in the future tells a good deal about whether the basic subsistence needs of a country's population are being and can be met. As crucial as food is, though, more is at stake for the world's poor than food; energy consumption, particularly of fossil fuels, reveals much about overall economic development and improvements in living standards, and it captures the intensity—and probable adequacy—of food production, as well. Stephen Schneider talked at Wingspread about world development in general as reflected in fossil fuel use.

Energy for Development

Today the developing world uses relatively little petroleum or the other fossil fuels, natural gas and coal. Indeed, the Third World, where three-fourths of the world's people live, uses only one-fourth of the world's oil, the dominant fuel. A number of developing countries use less than a single barrel of oil per person a year, while some rich nations use as much as 20 barrels per person annually.[8] As Kingsley Davis pointed out at the Conference, between 1960 and 1979, the world's wealthiest economies increased their per capita consumption of fossil fuels 33 times more than the poorest countries did.

By far the majority of people living in the developing world have little to do with fossil fuels; they rely on fuelwood, dung, and valuable crop residues to cook food and heat water. Indeed, the need for biomass has been called "the other energy crisis"; the poor in much of the Third World scour the landscape for every twig, leaf, and burnable scrap, and the countryside has severely deteriorated. The use of fossil fuels is creating a crisis of less immediate, but truly global, proportions. Acid rain, which damages inland fisheries and streams as well as lake ecosystems and which may damage forests, is closely linked to the burning of fossil fuels. The combustion of such fuels, and of coal in particular, also releases carbon dioxide into the atmosphere. The accumulation of excess carbon dioxide traps heat near the earth's surface; this process, called the "greenhouse effect," may warm the earth's atmosphere enough by the middle of the next century to create warmer and drier conditions in now-verdant farming areas and to raise sea levels enough to flood lowlands throughout the world.[9]

Scientists have said that temperature increases sufficient to affect the ice caps could occur unless there is no growth in world energy use over the next century and the use of coal is

phased out.[10] But closing the global gap in fossil fuel consumption between the rich and poor nations is likely to increase total consumption, particularly if conservation in the developed world progresses slowly. Indeed, a complete and immediate redistribution of total world oil production would give each person in the world four barrels of oil a year, much closer to the current levels in developing countries than in the developed ones.[11] Should developing countries therefore be encouraged *not* to increase their use of fossil fuels, which, in addition to perpetuating the current wide disparity in resource use between the rich and the poor, would probably slow economic growth in the developing world? Or should the Third World move ahead as fast as it can to consume more fossil fuels in the name of economic development, regardless of the environmental consequences?

Schneider offered a way to choose between these two "bad" alternatives. Developing countries should increase per capita consumption of fossil fuels, he said, if it brings about development that can lower birth rates, even though carbon dioxide accumulation and other pollution problems worsen in the interim. Schneider "would be able to accept a little additional pollution now if it meant that ultimately the world population would stabilize sooner and thus future pollution levels would be lower for any per capita standard of consumption" in the world.

High energy consumption is historically associated with wealth. Beyond a certain consumption level, more energy means not wealth but waste; both Sweden and Switzerland, for example, have higher gross national products per capita than the United States, which uses much more energy per capita than either of these two countries.[12] But for the developing world today, increasing energy use "would still bring marginal returns in terms of GNP growth," Schneider said at Wingspread.

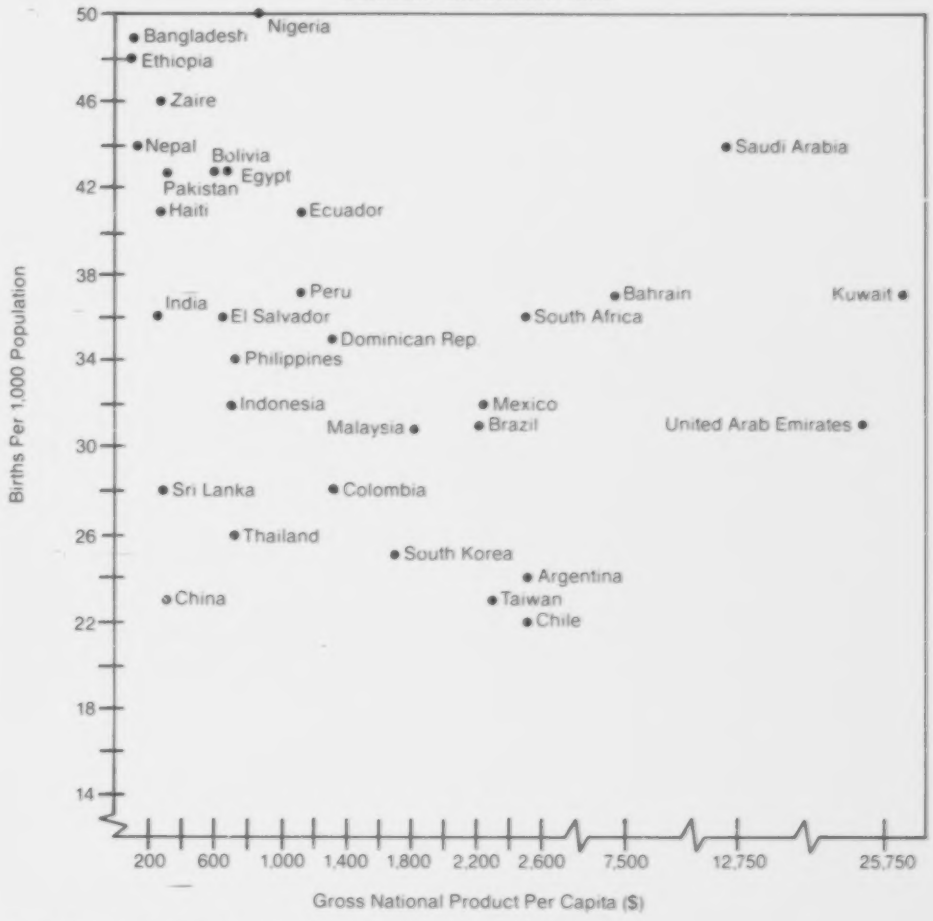
But the use of additional fossil fuels will be worth the price in pollution only if it buys development that lowers birth rates. Otherwise, the world will repeat history's mistakes: more population, consuming more, will only mean more pollution. How can we ensure that higher energy consumption brings development to the Third World that encourages a reduction in birth rates?

More energy usually means a higher gross national product and, by definition, a higher GNP per capita. But more GNP per capita does not necessarily mean lower birth rates in poor countries, as Figure 3 shows. And more GNP per capita does not necessarily mean a better standard of living, as Schneider pointed out in a discussion of the Physical Quality of Life Index (the PQLI).

The PQLI is a number composed of the infant mortality rate, life expectancy, and literacy rate in a country. Each country's rate is compared to the highest and lowest achieved anywhere in the world and assigned a number indexing it to those values. The three numbers are then averaged, with each given equal weight. In the early 1970s, PQLIs around the world ranged from a low of 12 in Guinea-Bissau to a high of 97 in Sweden.

Figure 4 shows that countries with similar PQLIs can have very different incomes per capita. Arab countries, for example, have relatively low PQLIs, even though the per capita GNP in OPEC Arab countries is as much as ten times as high as in non-OPEC Arab countries. In these nations, a rising gross national product does not necessarily raise the PQLI. In Latin American and Asian countries, the PQLI tends to increase as wealth increases. But for any given level of wealth, the PQLIs of Asian countries are higher than in other parts of the world. This may be because incomes are distributed more equitably in Asia than in other regions, according to Schneider. Regardless of the cause, it is clear that per capita GNP is not a reliable measure of well-being as measured by the PQLI.

Figure 3. Gross National Products Per Capita and Birth Rates, Selected Countries: 1983

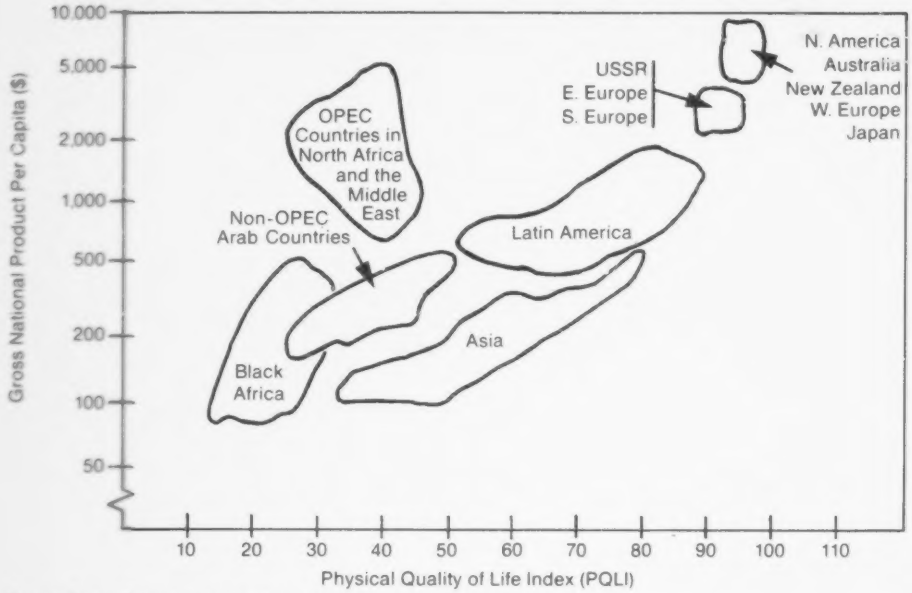


Source: Population Reference Bureau, updating Schneider

There is a close relationship, however, between PQLI and birth rates (see Figure 5), which suggests that countries putting money into strategies that reduce infant mortality, that lengthen people's lives, and that promote literacy are investing in reductions in birth rates. Thus, Schneider concludes that to reduce quickly "LDC birth rates without draconian measures, development strategies must concentrate on bringing up the PQLI, not just raising overall national GNP."

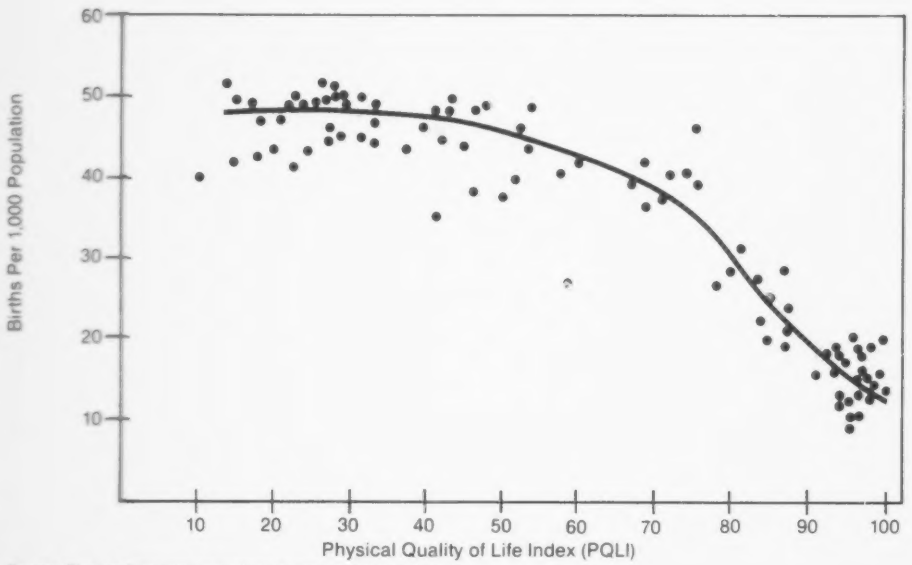
Schneider concludes that bringing up the quality of life and bringing down birth rates in the developing world is worth a relatively small increase in carbon dioxide and acid rain, because the benefits of a lower, stable population size as soon as possible are greater than the risks from marginally more pollution during the transition. For the gamble to be worth it, though, it must be taken now. Delay pays an enormous price in ultimate world population size and total damage from pollution. During

Figure 4. PQLIs and Gross National Products Per Capita, Early 1970s



Source: Stephen Schneider, from Harrison Brown and Morris Morris.

Figure 5. PQLIs and Birth Rates: Early 1970s



Source: Stephen Schneider, from Harrison Brown and Morris Morris.

the transition, too, Schneider pointed out at Wingspread, energy conservation and the development of alternatives to fossil fuels should be subsidized heavily. Reducing waste maximizes the amount of progress that can be attained at the cost of a given amount of pollution; alternatives to fossil fuels are necessary for a sustainable society in the future.

Policy Choices

Everyone speaking at Wingspread agreed that the most important element of bringing about a sustainable world in the long term is curbing population growth. Policies for encouraging a transition to a sustainable society cannot ignore fertility and population growth.

The world population today is 4.7 billion. Even if starting tomorrow the world's couples had no more than two children on average, or just enough to replace themselves, the world population would grow to 7 billion before stabilizing.[14] This is because there are so many young people around the world not yet in their childbearing years. Thus fertility must fall rapidly to prevent the peak population from greatly exceeding 7 billion. How can that be done?

Population growth slowed in Europe and North America as those regions industrialized. This change is called the "demographic transition" and is offered as proof that industrialization will also bring birth rates down in developing countries. But as Kingsley Davis pointed out at Wingspread, modernization that brings wealth such as industrial countries have is a slow process; "in the meantime, the population builds up to the point of interfering with modernization." That phenomenon is already occurring. Rapid population growth, combined with slowly growing or even contracting economies, is preventing per capita economic gains in some countries of the developing world today.[15] Those unrealized gains are the very ones that are supposed to reduce population growth.

Even if a demographic transition could bring birth rates down in the Third World it could not do so fast enough to prevent enormous projected increases in population, most often in countries least equipped to cope. Unless there is an unexpectedly rapid birth rate decline in Bangladesh, Pakistan, and the sub-Saharan African countries, for example, populations in those areas are projected to triple or even quadruple before they stop growing.[16] These countries are already on the margin of survival; it seems unlikely that even a doubled population could be supported for any significant length of time.

Kingsley Davis offered another reason why a demographic transition will probably not occur to bring down birth rates in the developing world: the situation there is fundamentally different from what it was for the now-advanced nations when they were going through the transition. The less developed countries today have a more rapid population growth rate—and larger absolute additions to their populations every year—than the industrial nations did at a similar stage. But the developing world lacks the frontiers that the United States, Australia, and New Zealand provided to migrating European populations—and to Americans migrating West—in the nineteenth and early twentieth centuries. There is also no resource frontier for developing countries similar to the one they provided colonial powers in earlier days. As a result, land resources in the Third World are strained today as they never were in the now-developed world.

Davis concludes that incentives and disincentives that compete with traditions encouraging large families are essential for birth rates to fall in the Third World. Family planning without incentives allows couples to have the number of children they want, Davis pointed out, which is usually too many for rapid population stabilization.

Combining Davis's recommendation on incentives with Schneider's on Third World

development suggests some strategies that could be financed in the Third World. These are family planning incentives designed to promote economic development and to raise the PQLI. These population policies are, in effect, development projects to lower birth rates.

Any project that creates employment in a Third World country—whether heavy industry, light manufacturing, public works, or a network of cottage industries—provides an opportunity to reduce birth rates. Literacy classes and health care, particularly services designed to improve infant health, can be offered in the workplace. Contraception can be readily available, free, and encouraged with incentives. Pension plans can encourage smaller families indirectly by substituting for child-provided old-age support; they can also be fashioned to compensate workers with two children more generously than workers with larger families. These kinds of projects could also be tried on the village level. Development that also lowers fertility can be promoted in a number of ways, often without increasing fossil fuel consumption on the scale that industrialization does. Villages can be rewarded with development projects—a well, irrigation, a diesel pump, livestock, a biogas plant, a school, roads, parasite control, or low-interest loans—as fertility falls or as more and more villagers use family planning.[17]

Curbing population growth is one of two efforts necessary to bring about a sustainable way of life on earth. The other is reducing consumption in the developed world. The disparity in food consumption between the rich and poor is widely known and documented; both Ehrlich and Pimentel spoke of it at the Conference. Changes in the diets of the wealthy could help relieve some of the stresses on agricultural resources discussed at Wingspread. Decreased demand would allow land, water, energy, fertilizers, and pesticides to be used less intensively. But, as Ehrlich pointed out at the Conference, "nothing short of a virtual reordering of the global political and economic system would be required for the people of the rich countries to reduce substantially their dependence on animal protein."

Less radical adjustments are possible in many other areas of affluent life that would significantly reduce environmental stress without enormous sacrifice—more energy-efficient cars and houses; land-use planning that avoids urban sprawl; pricing and using water for conservation, for example. Just improving efficiency in the use of energy and materials in known ways could stretch resources and reduce pollution a good deal. More research on greater efficiencies would accomplish even more.

Many of the characteristics of a sustainable society were discussed at Wingspread: building energy-efficient homes; developing crop strains that are energy- and water-efficient; widespread family planning services, to mention just a few. The complexity of the problems discussed at the Conference and the overlap among subject areas—food production, energy production and use, environmental quality, family planning, economic growth—suggest the complexity of the remedies required. The world cannot afford to delay in applying known remedies and should be searching actively for new remedies. David Pimentel articulated the alternative to bringing our use of resources into balance with the earth's long-term productivity: if we do not, he warned, "then nature will."

Footnotes

1. Population figures in this paragraph and throughout the essay, unless otherwise stated, are from Population Reference Bureau, *1983 World Population Data Sheet* (Washington, D.C.: 1983) and United Nations, *World Population Prospects as Assessed in 1980* (New York: 1981).
2. Presentation by Anne Ehrlich, Wingspread Conference, Racine, Wisconsin, March 6-8, 1983. Hereinafter, obvious references to presentations at the Conference will not be footnoted. Materials presented by one of the speakers not identified in the text will be footnoted as Ehrlich, Davis, Pimental, or Schneider.
3. Ehrlich.
4. Grain and acreage figures are from Lester R. Brown, *Population Policies for a New Economic Era* (Washington, D.C.: Worldwatch Institute, March 1983), pp. 10-11.
5. Ibid.
6. Centre for Science and Environment, *The State of India's Environment 1982: A Citizen's Report* (New Delhi: 1982), pp. 6-7.
7. Irish potato famine example is from Stephen H. Schneider and Randie F. Londer, *The Coevolution of Climate and Life* (San Francisco: Sierra Club Books, in press).
8. Figures on oil use in developing countries are from Daniel Deudney and Christopher Flavin, *Renewable Energy: The Power to Choose* (New York: W.W. Norton & Company, 1983), p. 11.
9. Explanation of greenhouse effect and acid rain is drawn from Schneider and Londer, *Coevolution of Climate and Life*.
10. J. Hansen et al., "Climate Impact of Increasing Atmospheric Carbon Dioxide," *Science*, August 28, 1981, p. 957.
11. Brown, *Population Policies*, p. 8.
12. This and other facts in this section are from Schneider unless otherwise indicated.
13. Morris D. Morris, *Measuring the Condition of the World's Poor: The Physical Quality of Life Index* (New York: Pergamon Press, 1979), pp. 128 and 134.
14. See, e.g., Tomas Frejka, "Long-Term Prospects for World Population Growth," *Population and Development Review*, September 1981.
15. See, e.g., World Bank, *World Development Report 1982* (Washington, D.C.: 1982).
16. Projected population increase if fertility does not decline rapidly is from computer projections provided by Tomas Frejka, The Population Council, New York.
17. See Judith Jacobsen, *Promoting Population Stabilization: Incentives for Small Families* (Washington, D.C.: Worldwatch Institute, June 1983) for a discussion of incentives in family planning programs.

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